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BOLL WEEVIL CONTROL IN A FIELD EXPERIMENT WITH A MACHINE DESIGNED TO DESTROY SHED COTTON SQUARES

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INTRODUCTION

The destruction of infested shed cotton squares (buds) by hand has long been recognized as an effective method of controlling the boll weevil (Anthonomus grandis Boheman).[3] Since no mechanical method of destroying the squares was available, their destruction was abandoned because of the great amount of labor required. However, the problem of pesticide residues on crops and the resistance of the boll weevil to insecticides emphasize the need for utilizing modern technology to develop other ways of controlling insects than with pesticides.

The adult female boll weevil deposits her eggs in the squares and bolls of the cotton plant; then 6 to 7 days after the egg is deposited, the squares and young bolls usually fall from the plant. The development of the weevil ranges from 13 to 24 days; thus, the weevil-infested squares or bolls will remain on the ground from 1 to 2 1/2 weeks.[4,5]

Parker et al.[6] reported that unemerged boll weevils in fallen squares or bolls could be destroyed by heat from a hooded burner designed to control weeds in row middles (space between rows). However, this operation was too slow to be practical.

Wilkes et al.[7] reported that survival of pink bollworms [Pectinophora gossypiella (Saunders)] was reduced by 85 percent when cotton stalks were shredded with a flail-type machine. These authors also reported that 30 to 40 percent of pink bollworm larvae in apparently undamaged bolls were killed, probably because of the impact of the flail.

A flail-type row-crop machine for destroying infested, shed cotton squares was recently designed and tested to determine the percentage of squares that could be destroyed and thus the control of boll weevils that might be obtained.[8] The machine picked up 84 percent of the fallen

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[3] Coad, B. R. Cotton boll weevil control in the Mississippi Delta, with special reference to square picking and weevil picking. USDA Bulletin 382, July 1916.

[4] Cushman, R. A. Studies in the biology of the boll weevil in the Mississippi Delta region of Louisiana. J. Econ. Entomol. 4(5): 432/448, 1911.

[5] Worsham, E. L. The Mexican cotton boll weevil. Ga. State Bd. Ent. B. 39, 24, p., Feb. 1914.

[6] Parker, R. E., Burt, E. C., Fulgham, F. E., and Merkl, M. E. Effectiveness of a USDA-developed middle flamer on boll weevil destruction inside cotton squares. USDA, ARS 42-104, October 1964.

[7] Wilkes, L. H., Adkisson, P. L., and Cochran, B. J. Stalk shredder tests for pink bollworm control, 1958. Texas Agr. Expt. Sta. Progress Report 2095, June 1959.

[8] Burt, E. C., Davich, T. B., Merkl, M. E., Cleveland, T. C. Mechanical destruction of fallen boll weevil infested cotton squares. Amer. Soc. Ag. Eng., SE Sec. Proc., Atlanta, Ga., Feb. 4, 1964.

squares and afforded control of the boll weevil equal to that obtained with the standard insecticides when migration of the insect was not a factor. In this report we describe results of tests in which a modified flail-type machine was evaluated; the machine was used where migrating boll weevils were not a problem.

MATERIALS AND METHODS

The Machine

The machine, (fig. 1) modified from the original flail model, consists of three flail units attached at the front end to an overhead framework. Gage wheels at the rear of each unit maintain constant clearance between the flail cylinder and the soil surface. Since the machine is designed for early season control of the boll weevil when the cotton plants are small, a maximum of only 10 inches, is allowed between flail units.

The machine is driven from the power take-off of the tractor. A system of chain drive and gear box drives a line shaft which spans the width of the machine. The flail cylinders are driven by two V-belts (B-section, 21/32 inch wide) from the line shaft. The chain, gear, and V-belt drives are adjusted so that the flail cylinders operate at 1,800 r.p.m. with a tractor power take-off of 540 r.p.m. and a forward speed of 1.7 m.p.h.

A self-cleaning blower supplies air for moving squares from the drill area underneath the plants into the middles between the cotton rows. The blower delivers 1,200 c.f.m. of air at a static pressure of 1 inch of water. Air nozzles with an inside diameter of 2 inches are mounted one per row, as shown in figure 2, to direct the air to the drill.

Evaluation of Machine Efficiency

The efficiency of the machine in controlling the boll weevil had to be tested under conditions such that adult weevils from surrounding areas would not be present, since adults are not killed by destruction of shed squares. Central Florida near Leesburg was selected as the test location because the nearest planting of cotton was 40 miles away and the soil and climate were suitable for production of cotton.

Two fields, each 1 acre in size, were planted to cotton and subdivided in check-plot and treated areas. Field 1 was infested with 50 pairs of virgin male and female boll weevils and field 2 with 25 pairs.

In obtaining the necessary data, all cotton plants were inspected on ten 100-foot lengths of row, selected at random, in each of the check and treated areas. The numbers of squares on the plants, punctures from oviposition, adult weevils, and shed fruiting forms from drill to drill were counted in each 100-foot sample. Shed fruit was collected and dissected for immature weevils. The numbers of weevils found were used to compute the population on an acre basis.

Machine efficiency was determined by counting shed squares before and after treatment on an area 10 feet wide by about 100 feet long. In the pretreatment count the fallen squares were painted with an orange aerosol paint to distinguish them from the squares that might be dislodged from the plants by the machine. After treatment, the squares remaining on the ground were examined and those undamaged and painted were considered as having been missed by the machine. At least one test of efficiency was completed at the time each field was treated.

Figure 1.--Rear view of the modified flail machine.

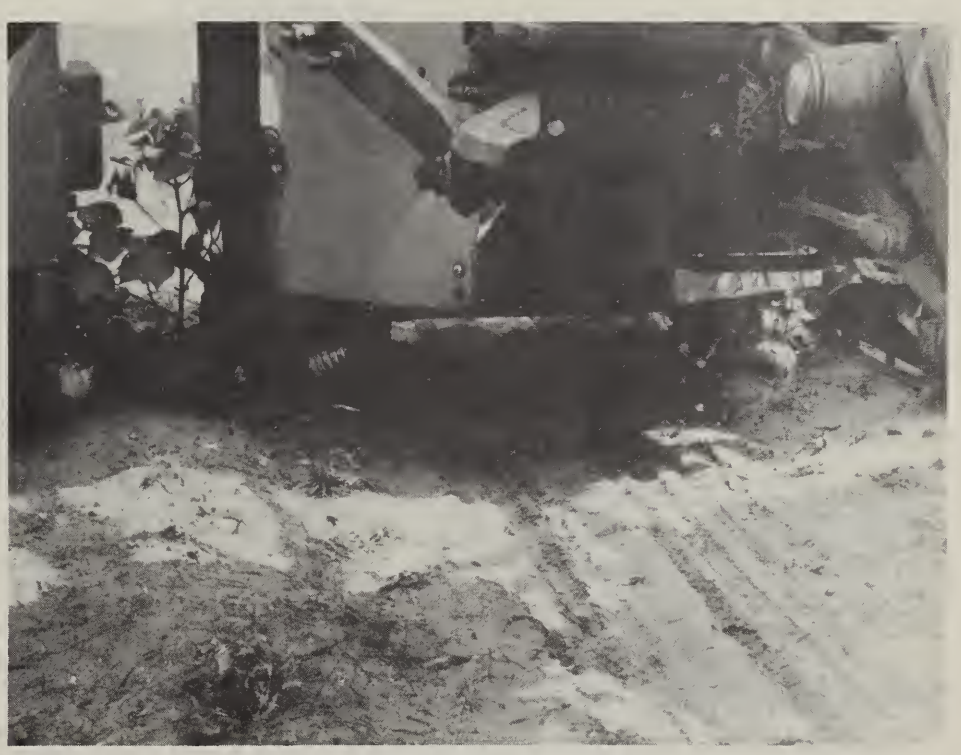

Figure 2.--The air nozzle arrangement for moving fallen squares from the drill into the middle.

RESULTS AND DISCUSSION

The efficiency of the machine in picking up the shed squares in the two fields ranged from 76 to 97 percent with a mean of 85 percent. Most of the squares the machine missed were in the drill area. This deficiency could be attributed to the difficulty encountered in adjusting the one air nozzle per row so that the air could uniformly move all the shed squares from the drill area to the middles. Two nozzles per row, crossed like the burners of a flame cultivator, would probably improve the efficiency of the machines in the drill area. In addition, it would be desirable to modify the machine to increase its ground speed so that it would travel at a rate comparable to that of other (tractor) farm operations (4-5 m.p.h.).

Data for the treated areas and check plot in field 1 are shown in table 1, and those for field 2 in table 2. The check plot in field 1 received no insecticide until July 18, when a weekly spray schedule of methyl parathion, 0.5 lb. per acre, was begun to minimize migration of adult boll weevils into the machine-treated plot. The data show that if the infestation is low when the cotton is in the early squaring stage and if migration of adult weevils later in the season is held to a minimum, use of the flail-type machine would control the boll weevil.

The infestation in field 2 did not develop to injurious levels in the check or in the treated areas, probably because of extremely hot, dry weather. Therefore in this field the degree of control of the boll weevil afforded by the flail-type machine could not be evaluated.

Table 1.--Percentage of punctured squares, number of squares, immature weevils and recovered adults per acre in field 1

Date (1964)	Punctured squares (%)		Number					
			Squares per acre		Immature weevils in squares on ground per acre		Adults on plants per acre	
	Check[1]	Treated[2]	Check[1]	Treated[2]	Check[1]	Treated[2]	Check[1]	Treated[2]
June 8	4.0	0.4	18,612	13,570	-	-	13.2	13.2
16	1.1	0.12	60,034	67,346	39.6	66.0	92.4	0
23	5.2	0.5	95,212	115,421	396.0	39.6	66.0	39.6
30	7.8	1.0	120,160	106,735	805.2	52.8	39.6	66.0
		0.5						
July 7	9.5	0.5	83,833	79,042	475.2	66.0	369.6	26.4
17	46.0	1.7	60,786	37,435	1,056.0	39.6	765.6	39.6
23	34.8	10.2	41,488	14,876	633.6	0	580.8	79.2
30	30.5	10.0	15,246	6,494	488.4	92.4	198.0	158.4
Aug. 5	61.7	37.8	7,788	594	118.8	26.4	52.8	13.2
Mean	22.3	6.9	55,907	49,057	445.9	42.5	440.0	48.4

[1] Check treated with 0.5 pound methyl parathion per acre on July 18, 24, and 30.
[2] Flail machine operated June 8-11, 16, 23, and 30.

Table 2.--Percentage of punctured squares, number of squares, immature weevils and recovered adults per acre in field 2

Date (1964)	Punctured squares (%)		Number					
			Square per acre		Immature weevils in squares on ground per acre		Adults on plants per acre	
	Check [1]	Treated [2]	Check [1]	Treated [2]	Check [1]	Treated [2]	Check [1]	Treated [2]
June 18	0.12	0.0	11,048	14,625	0.0	0.0	13.2	13.2
25	1.9	0.45	22,704	32,393	0.0	0.0	0.0	0.0
July 2	0.34	0.5	30,452	42,715	52.8	66.0	0.0	13.2
8	0.2	0.0	33,964	37,158	0.0	0.0	13.2	0.0
22	3.0	1.7	61,301	78,764	92.4	13.2	13.2	13.2
29	1.5	1.6	51,084	64,931	158.4	52.5	13.2	13.2
Aug. 3	3.7	0.6	55,572	58,476	158.4	0.0	105.6	0.0
Mean	1.53	0.69	38,018	47,009	66.3	35.74	22.6	7.54

[1] Check not treated with insecticide.
[2] Flail machine operated June 29-July 3, and July 8.

CONCLUSIONS

The following conclusions were drawn from results of the tests with the flail-type machine:

1. The population of boll weevils may be controlled if 85 percent of the infested fallen cotton squares are destroyed every 7 days provided the initial population of weevils is low and migrating adult weevils are not a factor.

2. Fallen squares can be destroyed mechanically with the flail machine. However, further work is needed to improve the efficiency of machine pickup, particularly in the drill area of the row, and to increase the effective ground speed of this machine.

USE PESTICIDES SAFELY

If you use pesticides, apply them only when needed and handle them with care. Follow the directions and heed all precautions on the container label. If pesticides are handled or applied improperly, or if unused portions are disposed of improperly, they may be injurious to humans, domestic animals, desirable plants, honey bees, and other pollinating insects, fish, and wildlife, and may contaminate water supplies.

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